Behind the scenes with the KC-135

By Eileen Hawley

NASA 930 and its follow-on aircraft NASA 931 have been used in the Reduced Gravity Program to provide researchers, astronauts and students with a unique laboratory in which to test their skills and theories.

Periods of zero gravity are achieved by flying a specific parabolic trajectory to provide about 25 to 30 seconds of weightlessness. The plane flies at an altitude of about 24,000 feet over the Gulf of Mexico. It then pulls up to about a 45-degree "nose high" profile, and at about 32,000 feet "arcs over" and descends for about 10,000 feet at a 45-degree "nose down" profile before the engines are powered back up to 450 miles per hour for the pull-out maneuver.

Periods of reduced gravity simulating lunar or Martian conditions can also be achieved by modifying the parabolic profile.

The KC-135 provides a truly unique environment to study the effects of weightlessness on people, hardware and technologies. But before anyone ever climbs on board the plane for a day of research and study, hours of behind-the-scenes maintenance and inspection are already complete.

"We have the elite in aviation technicians," said Sandy Sloan, heavy aircraft maintenance officer and flight engineer. "The ground crew keeps the airplane safe and reliable."

Three hours before flight time, the DynCorp ground crew begins its pre-flight check of the plane. It is a thorough inspection including checks of the plane's surfaces, hydraulics, struts, tires and fueling.

Once the pre-flight inspection is complete, there is a one-hour "hands-off" period. During that one-hour waiting period, the flight engineer performs a visual safety pre-flight inspection of the aircraft. The "hold" time ensures that maintenance crews don't overlap in their duties and provides time for any discrepancies noted by the flight crew during their inspections to be corrected without delaying the scheduled take-off time.

Finally, the pilot-in-command for that day's flight performs a walk-around inspection of the plane, usually accompanied by the flight engineer. In all, a minimum of three sets of eyes verify the plane's pre-flight readiness before anyone climbs on board to take to the air.

NASA JSC Photo 2000e04100 by James Blair

Hours of maintenance and pre-flight inspections are key to the success of NASA's KC-135 program.

"Our aviation technicians are all FAA certified," said Dave Mumme, KC-135 project pilot. "NASA set the standard for government contracts by requiring this certification. The quality emphasis has been enhanced and we wanted to increase the quality of maintenance."

Other government agencies are now beginning to follow suit, requiring FAA certification for aviation technicians.

As the flight engineer and pilot conduct their pre-flight inspections of the aircraft, the test director conducts pre-flight briefings and coordinates customer activities on board for that flight. The test director is also responsible for supervising the loading of equipment on board the KC-135. Before any equipment is loaded on board, though, test director John Yaniec and his staff have already reviewed experiment proposals and conducted thorough safety and test readiness reviews.

Once all pre-flight verifications are complete, the flight crew climbs on board and begins the process of configuring switches, checking equipment, receiving updated weather reports, verifying information and preparing for flight.

The standard flight crew for the KC-135 includes the pilot-in-command, the co-pilot, and a flight engineer in the cockpit and generally two test directors in the rear of the aircraft.

"Every pilot starts the day by making a decision if it's safe to fly today," said Mumme, who has more than 14,000 parabolas to his credit. "That decision is based on a combination of things including the aircraft condition, the weather and the people. The whole thing is a process and no one snapshot of that process accurately reflects the work that goes into flying."

Inside the cockpit, the flight crew begins its interior pre-flight operations. The co-pilot is responsible for working through a prescribed checklist of responsibilities, actions and safety checks.

"It's a challenge and response procedure," Mumme explains. "The co-pilot calls out an action and the responsible person responds verbally once the action is verified complete."

This sort of attention to detail doesn't stop when the pre-flight inspections are complete. Throughout engine start, taxi, take-off and landing, the crew is constantly working together to ensure a safe flight.

But flying parabolic maneuvers is hardly the sort of flight profile most aircraft crews perform as routinely as NASA's pilots and flight engineers do. In fact, the KC-135 generally flies 35 weeks a year, Tuesday through Friday.

Does the unique nature of zero-g flight make unique demands on the flight crew?

During the zero-g maneuvers, each member of the flight crew has specific duties to perform. The pilot controls the pitch axis of the aircraft – that is, the angle of the nose of the aircraft – while the co-pilot manages performance boundaries. The co-pilot is responsible for managing power to the KC-135's four engines, keeping the power to full-up until the moment the plane "goes over the top." At that time, the power is reduced almost to idle to create the zero-g environment.

"It's a constant litany of communication," said Mumme.

In the back of the plane, the test director is in constant communication with the cockpit crew. Yaniec works with a people from a wide variety of disciplines and cultures, coordinating their requirements during the periods of microgravity and ensuring they are operating safely.

It is Yaniec who advises researchers when the zero-g cycle begins and issues his familiar "feet down, coming out" warning just before the pull-out maneuver begins with its resulting 2-g force.

"Safety is my primary responsibility on board the plane," said Yaniec. "There's a lot of work taking place in the cockpit and in the back of the plane. We're conducting an orchestra up there." ■

Legendary KC-135 welcomes visitors to historic Ellington Field

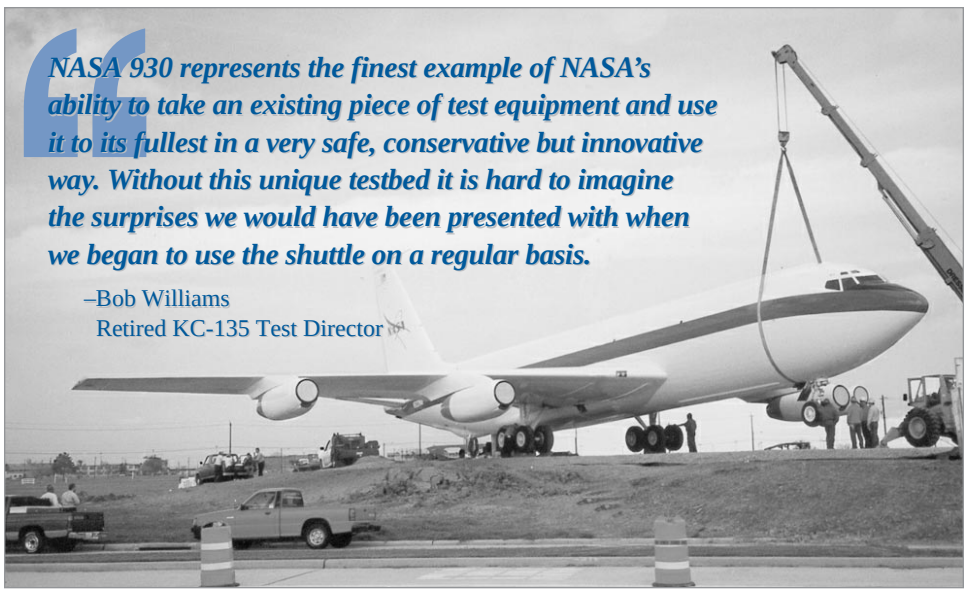
Standing as a massive, glistening monument at the gates to Ellington Field, one of NASA's most vital aircraft, the KC-135 known as NASA 930, was officially retired by NASA and bequeathed to the City of Houston in a dedication ceremony May 15.

City dignitaries including Mayor Lee Brown, aviators, and enthusiasts young and old all gathered to see the dedication of the plane, now skillfully poised over Aerospace Boulevard as a majestic tribute to its near 30 years of service to the space program.

"What we see here today is really a classic example of great cooperation between NASA Johnson Space Center, the aviation department and the City of Houston," said Mayor Brown who went on to declare May 15, 2000, as KC-135 Day in Houston. "It is clear to me that by working together we can accomplish some great things."

Many organizations that call Ellington home took a role in bringing the plane to its permanent site. The 147th Fighter Wing – Texas Air National Guard, the U.S. Army 149 helicopter Battalion, the U.S. Coast Guard, as well as Reliant Energy HL&P, and Houston Parks and Recreation Department worked with NASA's Aircraft Operations Division to coordinate the move of the historic aircraft.

"There are a lot of people who have played a big part in getting this airplane here," said JSC Center Director George W. S. Abbey. "All the pilots and commanders that have flown the space shuttle received heavy aircraft training in this airplane so it has played a major role in preparing crews for space flight. It represents a great deal of history and we're pleased that we have been a part of that program and were able provide this aircraft for the entrance to Ellington Field."



NASA-930, a KC-135 which played an extraordinary role in the space program, is hoisted to its new home at Ellington Field.

NASA 930 played a major role in heavy aircraft training for the shuttle pilots who, as typically very experienced military pilots, are accustomed to smaller, lighter and more maneuverable fighter jets.

"They generally have little or no heavy aircraft time," said A.J. Roy, a retired NASA pilot and the last pilot to fly NASA 930. "Coming into the shuttle program, they are not familiar with the crew concept or the inertia that plane has. Without exception, they find the airplane to be very challenging and very similar to the shuttle. It's been an invaluable training machine."

The modified KC-135 was also used extensively in the Reduced Gravity Program – a program initiated during the earliest phases of space flight that continues to serve as the primary zero-g testing ground for space flight hardware, in-flight procedures and crew familiarization.

"Maneuvering in zero g is a whole new ball game," said Dr. Chuck La Pinta who, as NASA's primary on-board physician for the KC-135 program since 1974, has experienced more than 20,000 parabolas. "It's an exhilarating sensation and quite frequently is accompanied by a sense of euphoria, but at the same time, it's stressful and physically demanding. It's quite a different experience for astronauts who, as fighter pilots, may have experienced zero g strapped tightly in the cockpit – to be floating and able to move like a world-class gymnast."

The reduced-gravity environment is created by raising the nose of the aircraft to a 45-degree nose high attitude, then pushing the nose over to achieve 25 seconds of zero gravity. When the nose is 45-degrees nose low, the maneuver is terminated and the aircraft is flown into another zero-gravity parabola.

"During those parabolas, a lot of good science goes on in the back of these aircraft," said Robert Naughton, chief of

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